

(12) UK Patent Application (19) GB (11) 2 286 282 (13) A

(43) Date of A Publication 09.08.1995

(21) Application No 9502072.3

(22) Date of Filing 02.02.1995

(30) Priority Data

(31) 08192896 (32) 07.02.1994 (33) US

(51) INT CL⁶
G11B 27/02 27/031

(52) UK CL (Edition N)
G5R RB784 RB789 RB81

(56) Documents Cited
None

(58) Field of Search
UK CL (Edition N) G5R RB81
INT CL⁶ G11B
Online: WPI

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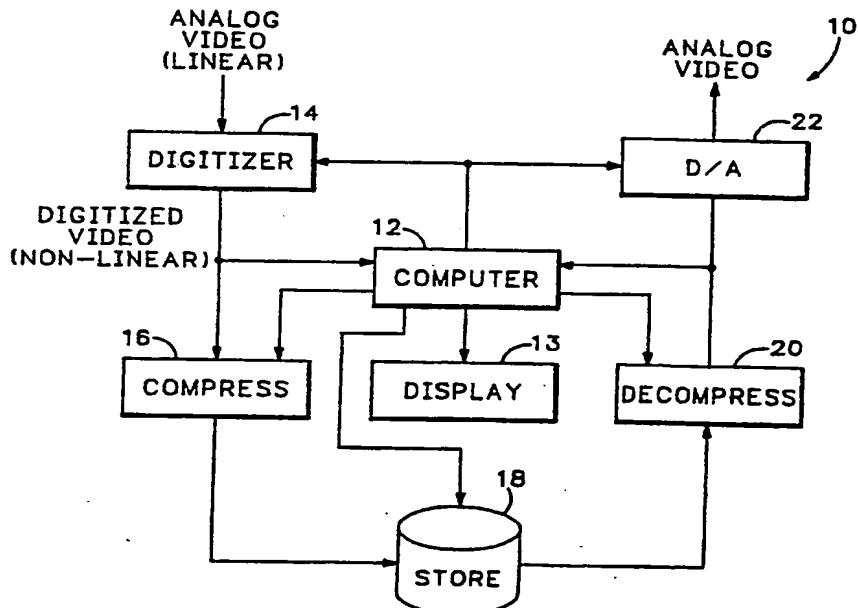
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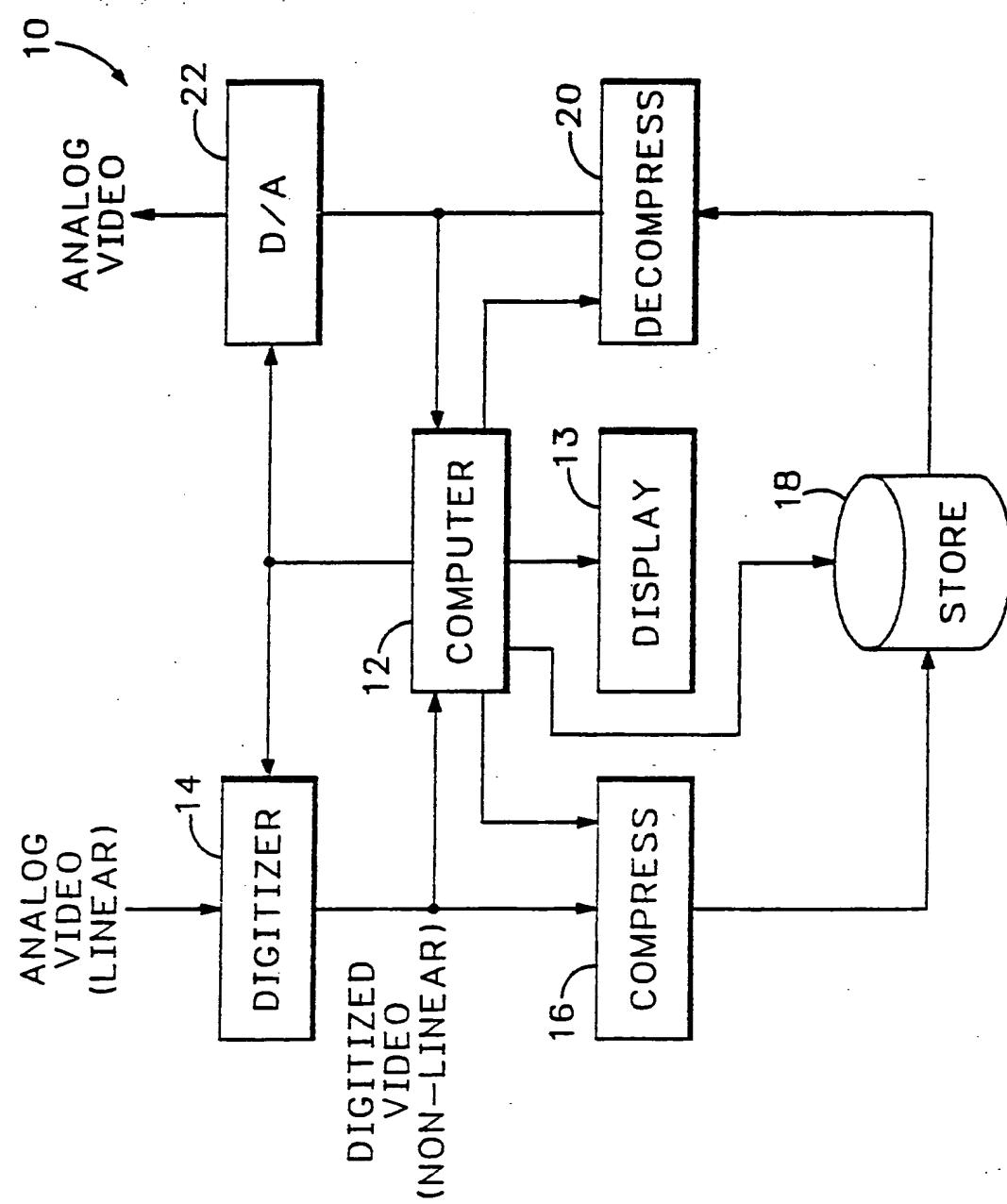
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(54) A non-linear video editing apparatus

(57) A spiral buffer for a non-linear editing system digitizes and stores an input video signal as it is simultaneously being cataloged by an operator. The digitized video signal is stored in a circular buffer of a random access non-linear storage device, 18 such as a disk recorder, wherein the old video data is overwritten by new incoming video data when the buffer is full so long as the old video data has not been marked by the cataloguing process to be retained. The video data is further edited which results in a spiral shrinking of the buffer.



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SPIRAL BUFFER FOR NON-LINEAR EDITING

Background of the Invention

The present invention relates to video editing, and more particularly to a spiral buffer for non-linear editing where a video signal is simultaneously converted from a linear to a non-linear format while being cataloged by an operator.

A linear editing system uses a linear video source, such as a camera or video tape recorder. As the video is played from the linear video source, an operator, either with manual annotations and/or computer assisted annotations, catalogs the material presented by the video. Cataloging is a process by which the operator identifies segments of the video that are to be kept or discarded. After the video has been cataloged, then the editing process is used to sort, order, crop and otherwise alter the video that has been kept by the cataloging process. In this manner a large amount of video may be reduced to a desired time frame, for example, reducing five hours of video to a twenty-four minute situation comedy episode.

Since the video source is linear, it has to be played sequentially to arrive at a particular segment of interest. This is time consuming, as it takes time to position video tape through shuttling and jogging operations. With the advent of non-linear storage medium, such as random access video disks, the time to access any particular segment is reduced. However another step in the editing process is added, namely converting the video from a linear form to a non-linear form, also called video capture. This conversion step is added either before or after the cataloging step, which requires the video to be played twice prior to the editing

step, once for cataloging and once for capturing for storage. Pictorially the conventional nonlinear editing process may be modeled as follows:

CAPTURE >> CATALOG >> EDIT >> OUTPUT

OR

5 **CATALOG >> CAPTURE >> EDIT >> OUTPUT**

The two approaches to capturing the video material involve either capturing all material prior to cataloging, which consumes large amounts of storage space, or capturing after cataloging, which consumes more of the operator's time. In the latter sequence the operator specifically must tell the system to capture the material when he finds a sequence which he may want to keep. The system must 10 then replay the sequence to capture and save it for storage.

What is needed is a non-linear editing process that further reduces the editing time and minimizes the amount of storage space used.

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Summary of the Invention

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Accordingly the present invention provides a spiral buffer for non-linear editing that minimizes the amount of storage space required. As an operator performs a cataloging step for an input video source, everything is converted from a linear to a non-linear form automatically, commonly called video capture. A circular buffer of user configurable size on a random access video disk storage medium is used to store this material. The space in the circular buffer occupied by the least recently used video material is reclaimed as more space is needed. Any video material that the operator marks during the cataloging step as "in" is marked as not discardable and retained. In this way the circular buffer shrinks

as the editing production grows, "spiraling" into a smaller size. When the operator wants to view a part of the video that he has already seen, if it was viewed within a time frame less than the total time stored on the circular buffer, it is still available for viewing from the disk. Thus the video capture phase is folded into the cataloging phase of the editing process so that the process model becomes:

CATALOG >> EDIT >> OUTPUT

The objects, advantages and other novel features of the present invention are apparent from the following detailed description when read in conjunction with the appended claims and attached drawing.

Brief Description of the Drawing

The Figure is a block diagram view of a non-linear editing system using a spiral buffer according to the present invention.

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Description of the Preferred Embodiment

Referring now to the Figure an editing system 10 includes a computer 12 that controls the editing process and with which an operator interfaces. Analog video from a linear source, such as a camera or video tape recorder, is processed by a digitizing circuit 14 to produce a digital signal while it is simultaneously viewed on a display 13 by an operator for cataloging and conversion into a non-linear form for storage, i.e., video capture. The digital signal is processed by the computer 12 for automatic annotations, such as scene changes and the like. The computer 12 also provides a mark for the digital signal in response to an operator

catalog input which indicates whether the particular segment is to be kept or discarded. The digital signal may be processed by a compression algorithm 16 and then stored on a random access non-linear storage device, such as a disk recorder 18. The computer 12 maintains a list of the locations for each video 5 segment together with the associated catalog mark, the list having a storage start address, length and catalog mark. Where the segment is broken into smaller pieces for storage, the list includes a point to the next piece of the segment.

On playback the computer 12 accesses the disk recorder 18 by directly retrieving a desired segment from the disk based upon the location(s) indicated 10 by the list. If the video segment is compressed, then the digital signal is processed by a decompression algorithm 20, and the decompressed digital signal is input to a digital to analog converter 22. The analog video from the digital to analog converter 22 is then available for display and/or recording on a linear storage device, such as a video tape recorder. The decompressed digital signal may also 15 be stored directly in the appropriate digital format on a digital tape recorder.

All of the incoming video material, whether analog or digital, is captured as it is being cataloged by the operator. A circular buffer, configurable in size by the operator, within the disk recorder 18 is used for storing the captured video signal as a nonlinear signal. As the circular buffer is filled up, the oldest video 20 segments are subject to being overwritten by the newest video segments. However the computer 12 only overwrites the oldest video segments which are not marked during the cataloging process by a "save" indication. In this manner the circular buffer need not be so large as to store the entire video signal to be edited, but only the marked video segments. The operator may recall any

segment from the disk recorder 18 and further edit it by pruning it, breaking it up into lesser segments, some of which are kept, and the like. As the "weeding" continues the circular buffer shrinks in size to hold only those segments that are retained. At the conclusion of the editing process the segments are read from the
5 disk recorder 18 in a sequence that produces a final linear video product that may be stored on a linear storage device.

Thus the present invention provides a spiral buffer for a non-linear editing system that is configurable in size, which size is less than the total amount of video to be processed, and while the video is simultaneously cataloged and
10 captured for storage on a random access non-linear storage device, new video material overwrites the oldest video material in the spiral buffer so long as the video material has not been marked as being kept.

CLAIMS:

1. A method of processing a video signal in a non-linear editing system comprising the steps of:

5 simultaneously cataloging and capturing for storage the video signal as it is received, the cataloging indicating which segments of the video signal are to be kept;

storing the video signal from the cataloging and capturing step in a circular buffer of a random access non-linear storage device as it is received; and

10 overwriting old segments of the video signal in the circular buffer with new segments of the video signal during the storing step when the circular buffer is full and the old segments have not been indicated by the cataloging and capturing step to be kept.

15 2. The method as recited in claim 1 wherein the cataloging and capturing step comprises the steps of:

marking the segments of the video segment to be kept with a catalog mark;
and

20 automatically listing a start location, a length and the catalog mark for each segment in the random access non-linear storage device as it is received.

3. A method of processing a video signal in a non-linear editing system substantially as herein described with reference to and as shown in the accompanying drawing.

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**Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)**

Application number
GB 9502072.3

Relevant Technical Fields

- (i) UK Cl (Ed.N) G5R (RB81)
(ii) Int Cl (Ed.6) G11B

Search Examiner
P R SLATER

Databases (see below)

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

Date of completion of Search
6 APRIL 1995

(ii) ONLINE DATABASES: WPI

Documents considered relevant following a search in respect of Claims :-
1-3

Categories of documents

- X: Document indicating lack of novelty or of inventive step.
Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.
A: Document indicating technological background and/or state of the art.

- P: Document published on or after the declared priority date but before the filing date of the present application.
E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.
&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
	NONE	